Medically Disqualifying Conditions Among Aircrew Candidates

Orr Groner; Yael Frenkel-Nir; Yifat Erlich-Shoham; Gal Shoval; Barak Gordon

BACKGROUND: Medical selection criteria for Israeli Air Force (IAF) Flight Academy candidates are strict due to the extreme physiological stressors during military flight. In various air forces the causes for medical disqualification of Flight Academy candidates are different, mainly due to differences in the selection process and criteria. In the present study, we examined the medical conditions leading to disqualification of candidates for the IAF Flight Academy.

METHODS: We reviewed the medical records of 3281 military Flight Academy candidates who underwent medical evaluation in the IAF Aeromedical Center between June 2016 and March 2018. For each disqualified candidate, we examined the cause or causes for disqualification divided into categories.

RESULTS: Out of 3281 Flight Academy candidates, 519 candidates (15.8%) were disqualified. The most prevalent cause for disqualification were ophthalmological conditions, which constituted more than half of the disqualifications (55.0%). Among the ophthalmological conditions, nonsatisfactory visual acuity constituted more than half (57.4%). The following most prevalent causes were asthma (7.9%), allergic rhinitis (7.3%), renal and urinary conditions, and otolaryngologic conditions (5.2% each).

DISCUSSION: The leading cause for disqualification of Flight Academy candidates was ophthalmological conditions, similar to other air forces. Our findings warrant an ongoing review of criteria for disqualification.

KEYWORDS: military pilots, flight academy, medical selection, medical criteria, disqualification.

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High standards of physical and mental fitness are desired among military aircrew candidates in air forces worldwide to meet the demands of the military aviation environment. Strict medical and mental standards were established in many air forces for selection of the fittest candidates, not only for effective completion of flying training, but also for further employability as military aviators. Candidates with medical conditions which do not fulfill the requirements for these standards are disqualified from aviation duty.[8]

The selection process in the Israeli Air Force (IAF) is under constant evaluation and adjustment in order to deal with challenges such as changes in the demands required for military aircrew, changes in properties of different aircrafts, developments in medical and mental examination techniques, and possibility of errors stemming from concealment or withholding of medical information by candidates.[1]

Few studies have been published concerning the medical causes of disqualification among aircrew candidates in air forces worldwide. We found three such studies.[3,4,8] The selection processes and criteria vary significantly between the different air forces described, making a direct comparison between them problematic. The most prevalent cause for disqualification in all air forces were ophthalmological conditions. Other leading causes of disqualification varied among the air forces and included systemic conditions (such as neurological and respiratory conditions), radiological spinal abnormalities, and anthropometric abnormalities. In the

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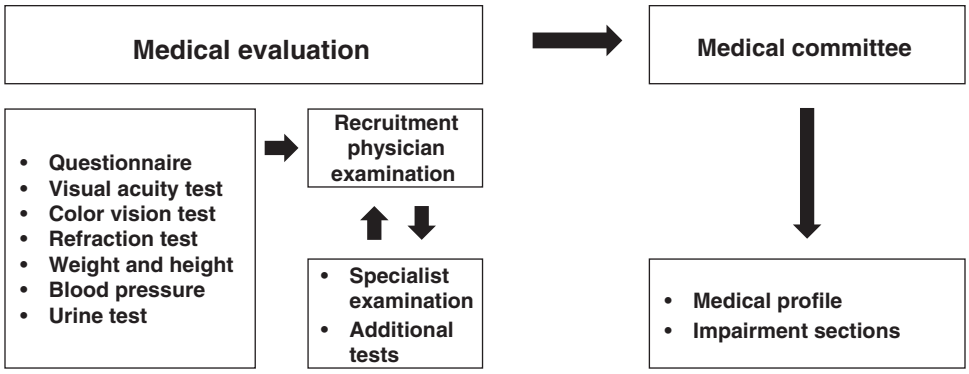

Fig. 1. Medical evaluation of flight academy candidates in regional recruitment centers.

present study, we examined the medical conditions leading to disqualification of candidates for the IAF Flight Academy.

METHODS

Subjects

This study is descriptive and retrospective. In this study, we reviewed the medical records of Flight Academy candidates in the IAF. The data in the medical records were collected as part of a policy review taking place apart from this study. For this reason, the study was exempted from ethical approval by the Israeli Defense Forces Medical Corps institutional ethical review board.

The selection process for Flight Academy candidates in the IAF consists of four tiers. The first tier is performed at the Regional Recruitment Centers, where all candidates for mandatory military service undergo basic evaluation. This tier includes a very large number of candidates and is meant for primary broad elimination from military service and for discerning crude medical functional limitations. It consists of a medical questionnaire, weight and height measurements, blood pressure measurement, visual acuity, refraction and color vision, urinalysis, examination by physician, and specialist's examination and additional tests if needed. After this process, a medical committee determines the medical profile of the candidate, which can be in one of five scaled grades of fitness to service, one grade of temporary disqualification, or one grade of permanent disqualification from military service (**Fig. 1**). In addition, as part of the nonmedical screening, evaluations of cognitive skills, language fluency, and motivation are performed, according to which a quality score is given. Military personnel are assigned to roles appropriate for their medical profile and quality scores. Approximately 88% of the candidates are eliminated from Flight Academy candidacy at the first tier, including those with a medical profile below the highest grade, BMI over 32, height over 1.95 or below 1.55 m, colorblindness, refractory impairment of more than −2, and a low quality score.

Candidates who pass the first tier continue to the second tier, which includes personality and flight skills evaluation. In this tier, and in those afterwards, all candidates must meet the standards for all aircrafts and positions. Because high-performance jet-fighter pilots are considered the most taxing role both mentally and physically, candidates are required to meet standards for this position. In the second tier, they undergo flight simulator tests, personality assessment, and psychological evaluation. This tier is not considered part of the medical evaluation and is not performed by physicians or medical staff. About 15% of the candidates pass this tier and continue to the third tier. The third and final tier before field testing is the medical evaluation in the IAF aeromedical center, which includes a more thorough medical questionnaire, laboratory tests, meticulous visual and hearing tests, ECG, blood pressure, weight and height tests, basic spirometry, ophthalmologist and otolaryngologist examinations, aeromedical physician examination, and additional specialist examinations and medical tests if needed. At the end of the medical evaluation, the aeromedical physician determines the candidates' fitness for Flight Academy according to the IAF medical criteria (**Fig. 2**). It is important to note that in the time that passes

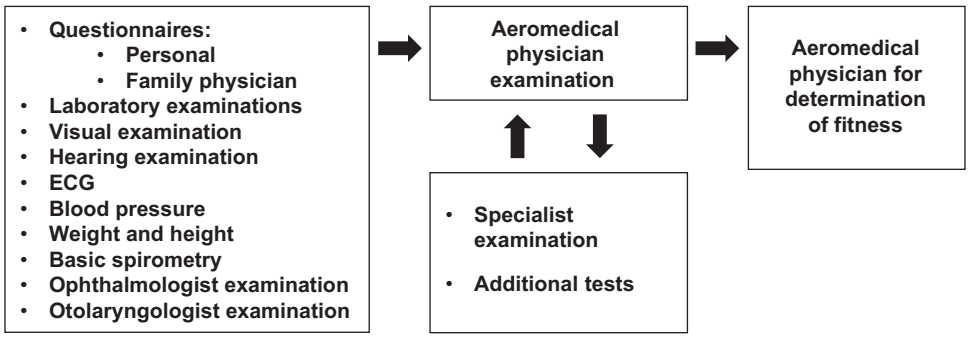

Fig. 2. Medical evaluation of flight academy candidates in the IAF Aeromedical Center.

between the first and the third tier, which is usually a few months, the medical conditions of some candidates change (for example shoulder dislocation, change in BMI, etc.). The evaluation in the IAF Aeromedical Center addresses the current medical status of the candidate.

The fourth tier consists of field testing the candidates. This tier is nonmedical. Medical disqualification after field testing is rare and, if it occurs, it is usually due to trauma or acute injury or illness. Disqualification after field testing is not included in this study.

The current study focuses on candidates who underwent the third tier of the selection process, which is the medical evaluation at the IAF Aeromedical Center. We sampled three consecutive cycles of medical classification for field testing between June 2016 to March 2018 as a sample of convenience. We reviewed the medical records of all candidates who entered the third tier of the selection process in this time frame. A total of 3281 aircrew candidates were included in the study.

Materials

The data was retrieved from the IAF Aeromedical Center medical files of the candidates. Records are kept electronically but do not facilitate digital data retrieval in a useful manner for this research. Therefore, all data was retrieved manually from these records. The different causes for disqualification were kept and analyzed anonymously using Excel charts.

Procedure

From each medical record, we produced the final status for qualification for the Flight Academy (Qualified/Disqualified), which was decided according to the medical criteria of the IAF Aeromedical Center. For the disqualified candidates, we examined the cause (or causes) for disqualification. The causes for disqualification were divided into categories which consisted of ophthalmological conditions (such as visual acuity under 6/6, spherical equivalent refraction of more than −1.75), asthma, allergic rhinitis, renal and urinary conditions, otolaryngological conditions, cardiovascular conditions, neuropsychiatric conditions (such as migraines, Tourette's syndrome), orthopedic conditions, gastrointestinal conditions, obesity, anemia, and other conditions (which included food allergies, dermatological conditions, pulmonary conditions other than asthma, and surgical conditions). Some of the categories were divided into specific conditions. The ophthalmological conditions were divided into nonsatisfactory visual acuity, refractive impairment, phoria, color vision impairment, depth vision impairment, strabismus, status post refractive surgery, keratoconus, and other conditions (which included amblyopia).

Statistical Analysis

This study is descriptive in nature. We calculated the percentage of medically disqualified candidates out of the sum of candidates who underwent the selection process. The different causes for disqualification were divided into categories and subcategories. Distribution of causes for disqualification is presented.

Table I. Disqualification Causes of Flight Academy Candidates Found During Medical Evaluation at the IAF Aeromedical Center.

CAUSE FOR DISQUALIFICATION	NUMBER OF DISQUALIFICATIONS	PERCENTAGE OF DISQUALIFICATIONS
Ophthalmological conditions	289	55.0%
Asthma	41	7.9%
Allergic rhinitis	38	7.3%
Renal and urinary conditions	27	5.2%
Other conditions	27	5.2%
Otolaryngological conditions	27	5.2%
Cardiovascular conditions	23	4.4%
Neuropsychiatric conditions	14	2.7%
Orthopedic conditions	14	2.7%
Gastrointestinal conditions	10	1.7%
Obesity	10	1.7%
Anemia	5	1.0%

RESULTS

A total of 3281 (10.2% female) aircrew candidates went through medical selection during the period of the study. Out of those, 519 candidates (15.8% of the total, 10.8% of them women) were disqualified from the Flight Academy.

The main cause for disqualification were ophthalmological conditions, which constituted more than half of the disqualifications (55.0%). The second most prevalent cause for disqualification was asthma (7.9%). The third most prevalent cause was allergic rhinitis (7.3%), and the fourth was renal and urinary conditions along with otolaryngological conditions (5.2% for each cause; **Table I**).

Among the ophthalmological conditions, visual acuity impairment constituted more than half (57.4%), followed by refractive impairment (14.5%), phoria (8.7%) and color vision impairment (7.6%) (**Table II**). Out of the renal and urinary conditions, the most prevalent disqualifying condition was hematuria (66.7%), followed by proteinuria (18.5%). Out of the otolaryngologic conditions, the most prevalent disqualifying condition was hearing impairment (63.0%), followed by anatomical ear abnormalities (25.9%) (**Table III**).

Table II. Ophthalmological Disqualifying Conditions of Flight Academy Candidates Found During Medical Evaluation at the IAF Aeromedical Center.

DISQUALIFYING CONDITION	NUMBER OF DISQUALIFICATIONS	PERCENTAGE OF DISQUALIFICATIONS
Visual acuity impairment	166	57.4%
Refractive impairment	42	14.5%
Phoria	25	8.7%
Color vision impairment	22	7.6%
Depth vision impairment	17	5.9%
Strabismus	8	2.8%
Other conditions	5	1.7%
Status post refractive surgery	2	0.7%
Keratoconus	2	0.7%

Table III. Non-Ophthalmological Disqualifying Conditions Of Flight Academy Candidates Found During Medical Evaluation at the IAF Aeromedical Center.

CAUSE FOR DISQUALIFICATION & DISQUALIFYING CONDITION	PERCENTAGE OF DISQUALIFICATIONS
Renal and urinary conditions (*N* = 27)	
Hematuria	66.7%
Proteinuria	18.5%
Anatomical abnormality	11.1%
Nephro/urolithiasis	3.7%
Otolaryngologic conditions (*N* = 27)	
Hearing impairment	63.0%
Anatomical ear abnormalities	25.9%
Other conditions	7.4%
Throat conditions	3.7%
Cardiovascular conditions (*N* = 23)	
Syncope	47.8%
Hypertension	26.1%
WPW syndrome	17.4%
Chest pain	4.3%
Myocarditis	4.3%
Neuropsychiatric conditions (*N* = 14)	
Migraine	78.6%
Other	21.4%
Orthopedic conditions (*N* = 14)	
Conditions involving knee	28.6%
Conditions involving back	21.4%
Conditions involving shoulder	14.3%
Conditions involving ankle	14.3%
Conditions involving elbow	7.1%
Conditions involving hip	7.1%
Conditions involving shin	7.1%

DISCUSSION

In our study, we examined the medical causes for disqualification among 3281 candidates for the IAF Flight Academy. Out of those, 519 (15.8%) were medically disqualified. We examined the results of similar studies in the U.S. Air Force (USAF), Indian Air Force, and the Republic of Singapore Air Force (RSAF). There is a significant variance between the selection processes and criteria between the different air forces; therefore, comparisons should be made with caution. In an analysis by Tripathy et al. in 2013,[8] the medical records of aircrew candidates in the USAF were reviewed for a 1-yr period. A total of 839 candidates underwent initial medical evaluation for flying duty during this time. Of those, 374 candidates (44.5%) were disqualified due to medical reasons. Waiver was granted in 310 cases (36.9%) and 64 candidates (7.6%) were permanently disqualified from aviation duty. In an analysis by Patil et al. in 2006,[4] 632 candidates were medically examined in the Indian Air Force between the years 1997 and 2004. A total of 229 (36.2%) were disqualified. Some of these candidates had more than one disability. Overall, 275 disqualifying disabilities were found. In a perspective of medical selection of aircrew candidates in the RSAF by Ng,[3] 8642 candidates were examined. Of those, 657 (7.6%) were rejected for nonmedical reasons before completion of the medical examination. Of the remaining 7778, 41.3% failed the selection examination.

We have found that the main cause for disqualification in the IAF was ophthalmological conditions, constituting more than half of the disqualifications (55.0%). Similarly, among the other air forces for whom we found published work, ophthalmological conditions were the most prevalent cause as well (65% in the USAF, 35.8% in the Indian Air Force, and 34.3% in the RSAF). In the category of ophthalmological conditions, the most prevalent condition in the IAF was nonsatisfactory visual acuity (57.4%), which constituted almost a third of the overall causes for disqualification (31.6%), while in the USAF it was color vision defects (40%), in the Indian Air Force it was refractive errors (76%), and in the RSAF it was myopia and astigmatism (57.6%). A high degree of visual function is highly important for military aircrew as 80–85% of all the information processed by an aviator is presented visually.[6] Visual selection criteria are therefore usually strict, which might explain the high rate of disqualifications. The IAF requires a strict criterion of visual acuity of 6/6 (with or without optometric assistance), which explains the high rate of disqualifications for non-satisfactory visual acuity. The rate of disqualifications for refractive and color vision impairment was significantly lower in the IAF as compared to the USAF and the Indian Air Force. This might be because many candidates with refractive and color vision impairments were disqualified during the first medical selection in the Regional Recruitment Centers in Israel before arriving at the third tier of selection in the Aeromedical Center, and so their causes for disqualification were not included in the results.

This work, as well as others in the IAF Aeromedical Center, resulted in a change in policy regarding refractive error and fitness for the Flight Academy. The new criteria allow for myopia up to −2.25 spherical equivalence for navigators and non-high-performance aircraft aircrew. Jet fighter pilots are still restricted to −1.75 spherical equivalence, as before. This policy change is predicted to increase candidates' potential for entering the Flight Academy.

Other causes for disqualification vary significantly from that reported in previous studies. The differences between the results might be explained by the significant variance between the medical selection process and criteria for Flight Academy candidates between different air forces worldwide. Specifically, in Israel many candidates are disqualified during the first tier of the selection process in the Regional Recruitment Centers and thus their causes for disqualification were not included in the results.

The second most prevalent cause in the IAF was asthma (7.9%), as opposed to different conditions in the other air forces, which included systemic conditions in the USAF (27%, mostly including respiratory and neurological conditions), radiological spinal abnormalities in the Indian Air Force (23.9%), and anthropometric incompatibilities in the RSAF (23.7%). Asthma is a disqualifying condition in most air forces.[2,5] The criteria for asthma in the IAF sorting procedure are meant to identify in advance and disqualify candidates with tendency for developing asthma, which might lead to frequent groundings and events of respiratory distress during flight and, in some cases, increase the risk for sudden incapacitation and pulmonary barotrauma. During the sorting procedure, any

evidence of asthma or use of medications for asthma in the 5 yr prior to the examination, or a pathological spirometry, disqualify the candidate. If there is evidence of asthma earlier than 5 yr prior to the examination, the spirometry results are borderline, and/or the candidate has a first-degree family member suffering from asthma, the candidate is required to perform a methacholine challenge test up to a concentration of 16 $mg \cdot ml^{-1}$. A borderline result of a methacholine challenge test requires a pulmonologist consultation and a pathological result disqualifies the candidate. In our study, out of 41 candidates disqualified because of asthma, only 1 candidate had a first-degree family member suffering from asthma as the sole reason for further testing and disqualification. These findings suggest that a review of the criteria for investigation of candidates with only family history of asthma is warranted.

The third most prevalent cause for disqualification was allergic rhinitis. Allergic rhinitis in pilots might increase the risk of developing acute sinusitis and barotitis, which poses a risk for barotrauma during flight.[7] This is demonstrated in a series of cases from the IAF Aeromedical Center by Ulanovski et al.,[9] where the prevalence of acute sinusitis in young pilots with allergic rhinitis was significantly increased in comparison to their peers without it. This study was the basis for the strict selection criteria for allergic rhinitis in aviation candidates in the IAF. During the medical selection, all candidates are examined by an otolaryngologist. During the study time, candidates with a history of allergic rhinitis above the age of 12 were disqualified. Candidates with a history of allergic rhinitis before the age of 12, without history of asthma and with a normal otolaryngological examination were summoned for a second examination at least 3 mo after the first one, and if the second examination was normal, they were declared as qualified. The selection criteria for allergic rhinitis have been updated recently following the results of the current study and are now less strict concerning the period that is mandated to be symptom free and the use of medication for relief of symptoms.

The fourth most prevalent cause for disqualification (along with otolaryngological conditions) was urinary and renal conditions, out of which the most prevalent cause was microscopic hematuria. Identifying candidates with microscopic hematuria during the medical selection is important because microscopic hematuria might suggest a greater probability of developing chronic kidney disease in the future. This is demonstrated in a study by Vivante et al.,[10] in which the medical records of 1,203,626 Israeli subjects ages 16 through 25 yr examined for fitness for military service between 1975 and 1997 were reviewed. Persistent asymptomatic isolated microscopic hematuria was associated with a crude hazard ratio of 19.5 for the development of end-stage renal disease in older age. The physical strain as well as transient partial dehydration during training and intensive activity time periods in a military aircrew career might raise the probability further. In the IAF selection process, a candidate with medical history of hematuria is disqualified during the first selection tier. During the third selection tier in the Aeromedical Center, the candidate performs a general urine test. If blood is present in at least two tests and the microscopy is positive (more than three red blood cells in a high-power field), the candidate is disqualified.

Our study has a few limitations. First, the number of candidates that were reviewed is limited and there is a need to expand the number of reviewed medical records in the future in order to receive a more comprehensive picture of the most prevalent causes of medical disqualification. Second, the possibility of candidates withholding medical information during the medical selection process exists, thus confounding the true prevalence of conditions. An example of this is shown in a 1988 study by Froom et al.[1] In this study, 3000 candidates for flight training were evaluated. Out of the candidates who were declared medically fit and started flight training, 46 cadets left the course for medical reasons. Out of those, eight cadets withheld information which would have led to their rejection on the original screening examination (including epilepsy, recurrent syncope, migraine, Crohn's disease, asthma, chronic knee pain, and chronic recurrent headaches).

In conclusion, in this study we examined the causes for disqualification of military Flight Academy candidates during medical evaluation in the IAF Aeromedical Center. The most prevalent cause for disqualification were ophthalmological conditions, specifically non-satisfactory visual acuity, followed by asthma, allergic rhinitis, renal and urinary conditions, and otolaryngological conditions. Policy review for the leading causes of disqualification is recommended.

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